RESEARCH ON BEAN RUST IN EAST AND CENTRAL AFRICA: STATUS AND FUTURE DIRECTIONS

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Introduction

Bean rust, caused by *Uromyces appendiculatus* is an important constraint to bean productivity in many countries of East, Central and Southern Africa. Among the major diseases, rust is ranked as the fifth most important constraint. Annual yield losses due to this disease are estimated at 191,400 t /year in Africa; 119, 000 t (Wortmann et al, 1998). Rust is of high importance (losses of 200 kg/ha) in Madagascar, Ethiopia, Mozambique, Malawi, Zimbabwe and South Africa; and of moderate importance (losses of 100 kg /ha) in Kenya, Uganda, Tanzania, Zambia, Lesotho, Swaziland, Rwanda, Burundi and DR Congo and Sudan. Rust management methods used by farmers include cultural practices especially sanitation and intercropping, fungicides and tolerant varieties. Use of resistant varieties is regarded as the most effective and economically viable strategy for rust management. The objective of national and regional breeding programs is to develop rust resistant cultivars. However, the achievement of this objective is constrained by lack of good sources of resistance, limited information on pathogen diversity, human and operational resources. Our objective is to describe the progress made in realizing these objectives and suggest directions for future research.

Results and Discussion

Research on rust in Africa has focused on identification, distribution, prevalence and economic importance, pathogenicity analysis, epidemiology in pure stands and mixtures, survival and spread, non-genetic control strategies, identification of sources of resistance and evaluation/screening for resistance by CIAT and national program scientists. Work on distribution, prevalence and economic importance culminated in publication of rust distribution map for Africa (Wortmann et al ,1998). Epidemiology work indicated that the disease is spread principally through windborne urediospores, contact with man and animals and implements, crop residues and volunteer crops (Allen, 1987). Seed transmission plays a minor role. Conditions favouring disease spread include cloudy, humid weather with heavy dew and temperatures of 21-27^{0}C. Telia are rarely seen eastern Africa and epidemics probably depend on transport of urediospores. There is no evidence that other legume species or alternative hosts serve as significant reservoirs of infection. Fininsa and Yuen (2001) showed that intercropping with maize and sorghum reduced mean rust incidence and severity was reduced by 25 and 16% in eastern Ethiopia. Although fungicides effective on rust have been identified, dry bean growers for economic considerations rarely use them

Available evidence indicates that considerable pathogenic variation occurs in Africa. Howland and Macartney identified six races in eastern Africa; six new races were reported in Tanzania (Macarteny,1966); Allen (1975) reported six races in Malawi. Habtu (1990) reported variability in Ethiopia; Rakotomalala and Rabakoarihanta (1995) in Madagascar and Liebenberg and Liebenberg (2000) in southern Africa. Comparison of these races is difficult either because standard differentials were not used or assessment methods were different A regional rust nursery coordinated by Ethiopia with 103 entries was constituted in 1989 and distributed for evaluation in Kenya, Uganda, Madagascar, Zambia, Mauritius, DR Congo. Twenty-four lines were rated resistant in Uganda, 40 in Ethiopia and 12 in Madagascar. Only PAN 134 was rated resistant in the three countries. This suggested pathogenic diversity. ExRico (Awash 1) rated resistant in Ethiopia was

susceptible in Madagascar. Further pathogenic diversity was indicated by variable reaction of the 20 standard differentials (Table 1).

Table 1. Reaction of 20 rust differentials to six isolates from Ethiopia and Madagascar.

Line	Ur gene	Ethiopian isolates			Madagascar isolates		
		Ambo	AN*	AW*	AKZ*	ATS*	FNR*
US No 3	Ur-3	R	I	R	S	S	S
CSW 643	Ur-3	R	R	R	-	-	-
Pinto 650	Ur-3	R	I	I	S	S	S
Kentucky Wonder 765	Ur-3	I	I	I	-	-	-
Kentucky Wonder 780	Ur-3	I	I	I	I	I	R
Kentucky Wonder 814	Ur-4	R	R	R	S	S	I
Golden Gate Wax	Ur-4	R	I	I	S	I	R
Early Gallatin	Ur-4	R	R	R	R	?	?
Mountaineer	unknown	I	I	I	I	I	R
Redlands Pioneer	Ur-5	I	R	R	I	I	R
Ecuador 299	Ur-6	R	R	R	R	R	I
Mexico 309	Ur-8	R	R	R	-	-	-
Brown Beauty	Unknown	R	I	R	R	I	I
Olathe	Unknown	I	I	I	I	R	R
AxS37	Unknown	R	R	R	R	S	I
NEP 2	Unknown	R	R	R	R	R	S
Aurora	Unknown	R	R	R	R	I	R
51501	Unknown	R	R	R	R	I	I
CNC	unknown	R	R	R	R	R	R

Sources of isolates: AN= Arsi Negelle, AW= Awassa, AKZ=Ankazobe, ATS=Antisirabe and FNR=Fianarantsoa; seeds of CSW 643, Kentucky Wonder 765 and Mexico 309 failed to germinate in Madagascar.

In the field studies, the differentials showed reactions that varied with locations and seasons. However, Kentucky Wonder 814, Ecuador 299, Mexico 309, NEP 2, Aurora, 51051 and CNC showed consistent resistant reactions at Ambo, Awassa, Debre Zeit and Melkassa in Ethiopia for two years. This indicated that deployment of ur-4, ur-6 ,ur-8 and other genes may be effective against races prevalent in this region.

Efforts to incorporate rust genes in popular local cultivars started in 2001 in the recently developed market led programs linking 20 national programs in Eastern, Central and southern Africa. Rust is a major problem in small reds, pinto, navy and snap beans. To develop cultivars with potential for production in many countries, it will be necessary to determine the pathogen diversity in these countries and identify rust genes that could be deployed. The current differentials do not represent all the known rust genes and needs to changed to better reflect the current status of knowledge. An African Bean Rust working group was formed in March 2002 during the Third International Rust Workshop in South Africa to coordinate research on bean rust in Africa.

References

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